Contents


Insect Pest Activity ▷ . . . . . 2
Disease Activity ▷ . . . . . 3
Introduced Species ▷ . . . . . 4
Aerial Survey ▷ . . . . . 6
Abiotic Information ▷ . . . . . 7


# Forest Health highlights

- CALIFORNIA
- APRIL 2008

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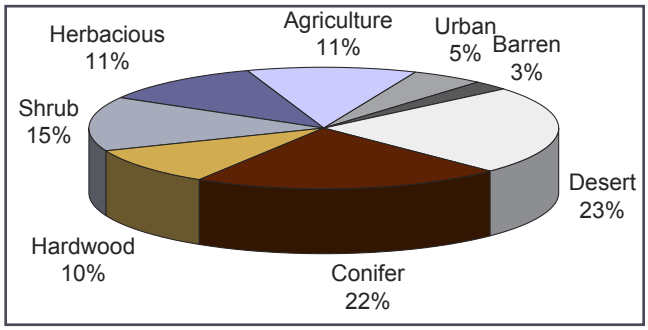
## Forest Resource Summary

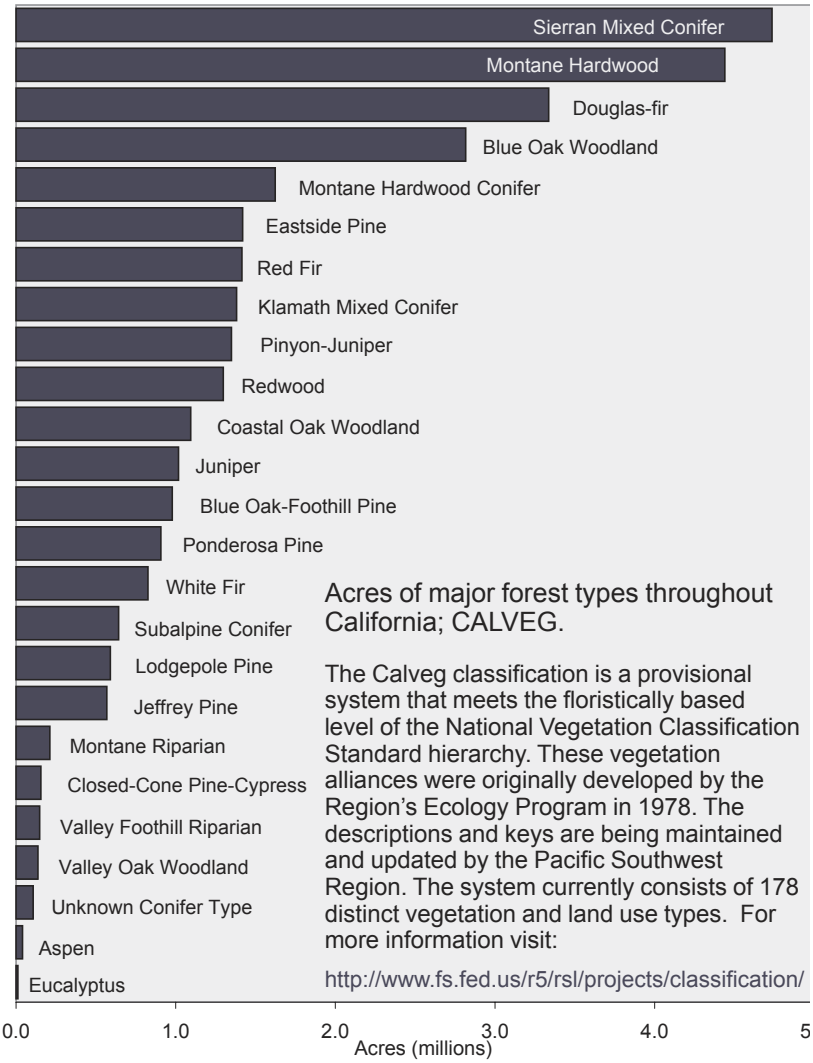
The USDA Forest Service and the California Department of Forestry and Fire Protection regularly map, measure, monitor and assess California's forested lands. California's forests are among the most complex and diverse in the nation, with 25 major forest types occurring over 32 million acres throughout the state.

Approximately 33% of California is forested. These forest resources are susceptible to a variety of forest insects and diseases depending largely on tree species composition, tree stocking, drought, air pollution and other environmental factors.




California land cover types by percent of total land base.

This report highlights forest health conditions in California in 2007. Some of this information has been taken from the annual report of the California Forest Pest Council, *Forest Pest Conditions in California - 2007.* It does not purport to be a historic review or an in-depth consideration of any particular forest insect or disease organism or abiotic influence.




Acres of major forest types throughout California; CALVEG.

The Calveg classification is a provisional system that meets the floristically based level of the National Vegetation Classification Standard hierarchy. These vegetation alliances were originally developed by the Region's Ecology Program in 1978. The descriptions and keys are being maintained and updated by the Pacific Southwest Region. The system currently consists of 178 distinct vegetation and land use types. For more information visit:

http://www.fs.fed.us/r5/rsl/projects/classification/

## National Forests of California

There are 18 National Forests in California, totaling over 20 million acres. These National Forests account for 25 percent of National Forest recreation nationwide and about half of the public wildland recreation in California. National Parks and other federal, state, county and private lands provide the remainder. http://www.fs.fed.us/r5/

## Bark and Engraver Beetles

Mortality of Jeffrey pine caused by **Jeffrey pine beetle** continued to increase on the east side of the Sierra Nevada range this year from the Inyo National Forest north to the Lake Tahoe Basin Management Unit. Jeffrey pine mortality is expected to continue to increase in these areas in 2008.

**Mountain and western pine beetle** activity remained low in 2007, as evidenced by low levels of tree mortality, with the exception of a few areas on the Modoc, Lassen and Klamath National Forests. Specifically, continued mountain pine beetle-caused mortality was observed on ponderosa, lodgepole, western white and whitebark pine on the Warner Mountain Ranger District, Modoc National Forest. There was an increase in mountain pine beetle activity in lodgepole pine on the Lassen National Forest, Hat Creek and Almanor Ranger Districts. Several thousand acres of lodgepole pine were killed by mountain pine beetle on the Goosenest Ranger District, Klamath National Forest. Very low levels of conifer mortality were detected throughout Southern California, despite relatively low annual rainfall.

Most of California experienced low to moderate levels of **fir engraver** activity. However, fir engraver-caused tree mortality in conjunction with overstocking, dwarf mistletoe, cytospora canker and annosus root disease continued at the same elevated levels seen in 2005-6 in a few areas of California. Elevated levels of white fir mortality continued on the Warner Mountain, Big Valley and Doublehead Ranger Districts, Modoc National Forest and throughout the entire red fir belt on the Tahoe National Forest. Red fir mortality was also noted at higher elevations throughout the Sierra Nevada range.

Continued mountain and western beetle-caused mortality of ponderosa, lodgepole, western white and whitebark pine on the Warner Mountain Ranger District. Photo: D. Cluck

## Defoliators

Acres of white fir defoliation from **Douglas-fir tussock moth** decreased in the Sierra and Stanislaus National Forests and defoliation was not detected in Yosemite National Park in 2007; over 20,000 acres of defoliation were mapped in these areas in 2006. However the Douglas-fir tussock moth outbreak in Shasta County entered its third year with a significantly larger area of defoliation. Over 7,000 acres of defoliation were mapped in the vicinity of Bear Mountain, east of McCloud Flats, including both the Shasta-Trinity National Forest and private lands (USFS Aerial Survey Program). This was an increase from 2,455 acres of defoliation mapped in 2006.

Douglas-fir tussock moth outbreak near Bear Mountain lookout, Shasta County. Photo: D. Owen

The outbreak of the lodgepole needleminer continued in Yosemite National Park caused fifteen thousand acres of defoliation (USFS Aerial Survey Program). This was an increase from 14,000 acres of defoliation detected in 2006. Personnel conducting ground surveys found that most of the defoliation was at low to moderate levels.

Leaf injury caused by an **unknown oak leaf miner** was observed in black oak again in 2007 at a few locations on the Plumas and Tahoe National Forests. However, the defoliation was greatly reduced from the levels seen during the previous two years. Specimens were collected this past spring and are pending identification. No trees or individual branches have died as a result of defoliation.

Unknown oak leaf miner larvae and damage on black oak. Photo: D. Cluck

**Annosus root disease** in ponderosa pine north of State Hwy Highway 44 on the Eagle Lake Ranger District, Lassen National Forest appeared to be inactive in many formerly active infection centers. The decrease in pine mortality caused by the disease may be the result of the Forest treating stumps with borax for the last three decades. The borax fungicide, now registered as SPORAX®, prevents *H. annosum* spores from infecting stumps and moving into connected root systems where it can persist for thirty years or more, killing pine regeneration and adjacent mature pine trees.

Annosus root disease continued to cause scattered pockets of mortality in ponderosa pine on McCloud Flats on the Shasta-McCloud Management Unit, Shasta-Trinity National Forest. Ponderosa pine mortality was particularly high on Forest Service land south of the Shasta Forest subdivision, approximately four miles northeast of McCloud.

**Black stain root disease,** caused by *Leptographium wageneri*, continued to kill young and old ponderosa and Jeffrey pine trees east of State Hwy 139 between Willow Creek Campground and Heartrock on the Big Valley Ranger District, Modoc National Forest. Bark beetles are also associated with the conifer mortality. Four miles south, *L. wageneri* and bark beetles continued to cause pine mortality west of Hwy 139.

*L. wageneri* and bark beetles continue to cause pine mortality west of Hwy 139. Photo: W. Woodruff

Conspicuous concentrations of mortality around black stain root disease centers were evident at the Mud Flow Research Natural Area (Shasta-McCloud Management Unit, Shasta-Trinity National Forest).

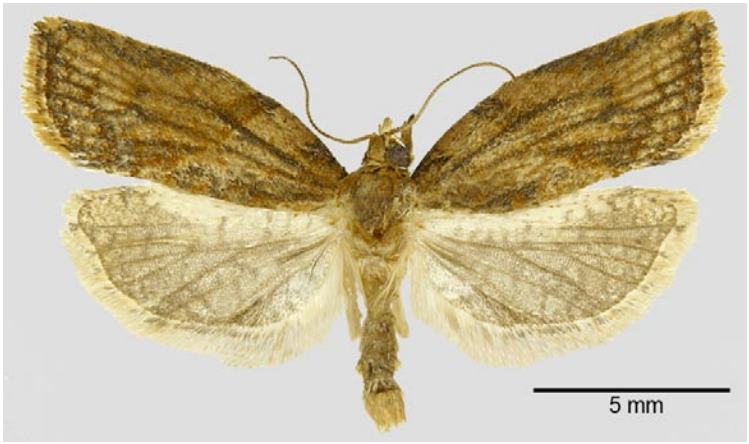
Black stain root disease centers were widespread and scattered in Douglas-fir plantations in the Wild Azbill Timber Sale Area (Round Valley Indian Reservation, north of Covelo, Mendocino County). Black stain root disease was also found in two Douglas-fir plantation stands near Black Mountain, north of Orleans (Orleans Ranger District, Six Rivers National Forest).

In 2005 and 2006, **Cryptosphaeria dieback**, a new disease of Fremont cottonwood (*Populus fremontii*) and possibly Lombardi poplar (*P. nigra*) was detected throughout riparian areas in Napa, Sonoma, Solano, Merced, Sacramento, Yolo, Stanislaus and El Dorado Counties. Infected trees had severe limb and twig dieback. Brown discoloration and decay in both sapwood and heartwood. Symptoms were often associated with the presence of fungal fruiting bodies on the surface of the bark. Preliminary identification of isolates obtained from cankers in Fremont cottonwood revealed a new *Cryptosphaeria* species to be associated with this disease. Ecological disturbances and water stresses in the native habitats of cottonwoods may have encouraged this new disease to develop.

Severe symptoms of Cryptosphaeria dieback in a Fremont cottonwood tree. Photo: F. Trouillas

The **light brown apple moth,** an invasive species originally from Australia, was detected in Berkeley in 2006. Since then the California Department of Food and Agriculture has trapped over 15,000 moths, mostly in the San Francisco Bay Area and along the central coast. Although mainly an agricultural pest, the light brown apple moth could affect several tree species including eucalyptus, fir, oak, pine, poplar, spruce and willow. Containment and eradication efforts are ongoing.

The **redhaired pine bark beetle** was first detected by the California Department of Agriculture in Los Angeles County in 2003. Since then, hundreds of redhaired pine bark beetles have been collected in flight traps in six counties in Southern California (Los Angeles, Orange, Riverside, San Bernardino, San Diego and Ventura). The only new find in 2007 was a single beetle in a green waste pile in Long Beach. Adult beetles are attack and reproduce in freshly cut stumps, slash and logging debris. In unhealthy *Pinus* spp., the beetle usually breeds in thick bark near the base of the stem or in large exposed roots. Newly emerged adults may attack seedlings and stressed pole-sized trees. Adult beetles carry *Ophiostoma* and *Leptographium* spp. fungi, which have been implicated in staining and pine root decline diseases, respectively.




Adult light brown apple moth. Photo: Todd Gilligan

**Port-Orford-cedar root disease** continues to infest and kill Port-Orford-cedar throughout the host range in California. The disease was present along the main stem of the Sacramento River from Dunsmuir to Shotgun Creek (Siskiyou and Shasta Counties). A survey at Castle Crags State Park detected root disease and dying trees upstream from the suspension foot bridge on the Sacramento River. All Port-Orford-cedar in the diseased area will be cut as part of an ongoing effort to slow disease spread and mitigate its impacts within the Park. The Trinity River drainage (Trinity and Shasta Counties) remains is the only uninfested major river drainage within the range of Port-Orford-cedar.

Port-Orford-cedar mortality due to Port-Orford-cedar root disease in Castle Crags State Park on the Sacramento River. Photo: P. Angwin

Elevated levels of dieback and mortality from **white pine blister rust** occurred among pole-sized to mature western white pine on Latour State Forest, Shasta County. The rust was also detected on the east slope of Mt. Lassen, killing branches and tops of western white and whitebark pine trees. White pine blister rust also caused branch and stem dieback in sugar pine on Monumental Ridge, American River Ranger District (Tahoe National Forest) and killed the tops of some western white pine seedlings along the trail from Squaw Valley Village to the tramway summit in Tahoe National Forest.

**Pitch canker** increased within the coastal pitch canker zone of infestation in California in 2007; but did not spread outside of the previously infested areas. Notable areas of infestation included Benicia State Recreation Area (Solano County), Point Lobos State Park (Monterey County), Point Reyes National Seashore (Marin County), Santa Maria (Santa Barbara County) and Arroyo Grande (San Luis Obispo County).

The removal of trees infected with or killed by the pitch canker fungus has resulted in more open sites at Benicia State Recreation Area. Photo: M. MacKenzie

The exotic pathogen *Phytophthora ramorum* has been killing tanoaks and other oak species in coastal California for more than ten years. Wet springs in 2005 and 2006 favored inoculum production and incited a severe second wave of mortality in 2007 in several coastal California counties. In 2006, more tanoak died than in any previous year of the epidemic. In 2007, the level of mortality in coast live oak, which generally take longer to die than tanoaks, caused increased alarm. The disease is especially apparent in the densely populated urban-wildland interface areas in Sonoma, Marin, San Mateo, Santa Clara and Santa Cruz Counties. Homeowners in these counties are dealing with fatally infected trees and the increased hazards of dead trees.

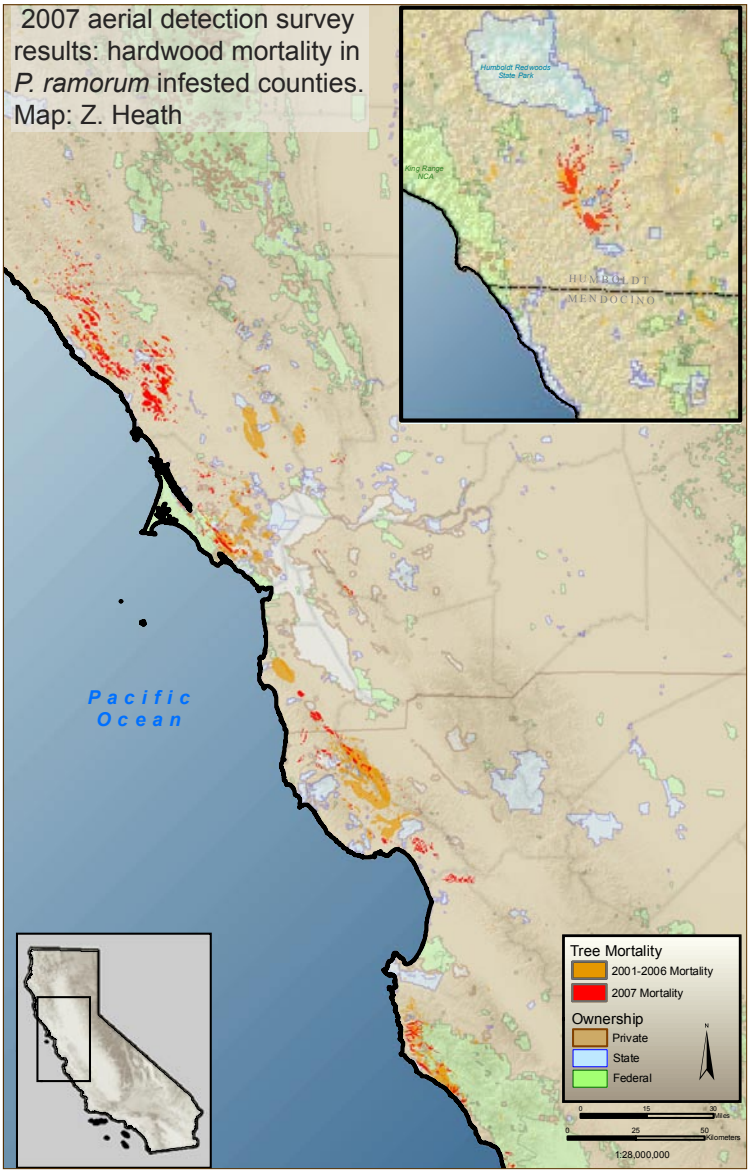
Sudden oak death pathogen spread is greatly facilitated by wet, warm weather, and by the many foliar hosts in forests and nurseries which carry and distribute its spores. Though *P. ramorum* has not spread outside the 14 confirmed counties in California, spread in southwest Oregon and its continued presence in nurseries highlight the potential for further introductions and new outbreaks. Maps of *P. ramorum* confirmations and other pertinent information regarding this disease can be found online at the California Oak Mortality Task Force website, www.suddenoakdeath.org.

2007 tanoak mortality in Big Sur. Photo: Kerri Frangioso

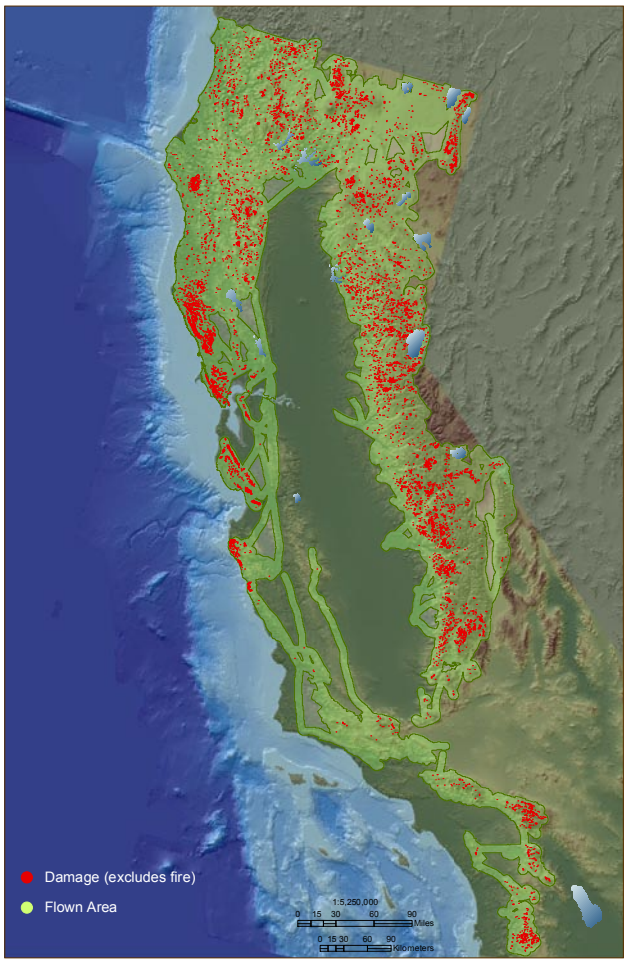
**Surveying and monitoring.** In 2007, 132 sites in perennial watercourses from the Oregon border to southern San Luis Obispo County, plus a cluster of sites in the Sierra Nevada from El Dorado to Butte Counties, were monitored for the presence of *P. ramorum.* Sixty-five of these sites had not been previously monitored. *P. ramorum* was detected at only fifteen sites (seven of them new in 2007), reflecting the paucity of recovery of *P. ramorum* from California terrestrial vegetation due to the dry 2006-2007 winter and spring. At all sites, the pathogen was recovered much less often and in lower quantities than in previous years. In 2006, the results from stream monitoring expanded the known northernmost and southernmost extents of the range of *P. ramorum* in Humboldt and Monterey Counties, as well as enabling the detection of inoculum in a small urban creek in Humboldt County 47 miles from the nearest forest infestation. 2007 stream monitoring prompted no changes in these boundaries. All watercourses in the Sierra Nevada remained negative for *P. ramorum* inoculum.

In 2007, USDA Forest Service aerial survey personnel flew 1,000,000 acres in San Luis Obispo and Monterey Counties and detected 2,589 acres of tanoak and coast live oak mortality. The survey also covered 626,000 acres in Del Norte County (628 linear miles) where 60 acres of mortality were detected. Forest Service crews ground-checked most of the tanoak mortality points in Del Norte County and determined them to be caused by agents other than *P. ramorum.* As part of its general survey for plant injury caused by insects and diseases, some other coastal counties were also flown and checked for tanoak and oak mortality. Results of these surveys are available on the Forest Health Monitoring website at:

http://www.fs.fed.us/r5/spf/fhp/fhm/aerial/.




2007 aerial detection survey results: hardwood mortality in *P. ramorum* infested counties. Map: Z. Heath




Area flown and injury detected in 2007.
Map: Z. Heath

The US Forest Service Forest Health Protection program conducts aerial detection surveys nationally. Surveys have been conducted in the Pacific Southwest Region annually since 1994. Data is collected using a digital aerial sketch mapping system and follows national protocols in order to provide standardized information on biotic and abiotic damage on California's forested ecosystems.

Approximately 44 million acres were flown in California in 2007, including almost 20 million acres of Forest Service land and almost 19 million acres of private land.

Approximately 791,000 acres with mortality or injury were detected in California; this includes 347,000 acres caused by biotic agents such as bark beetles and diseases.

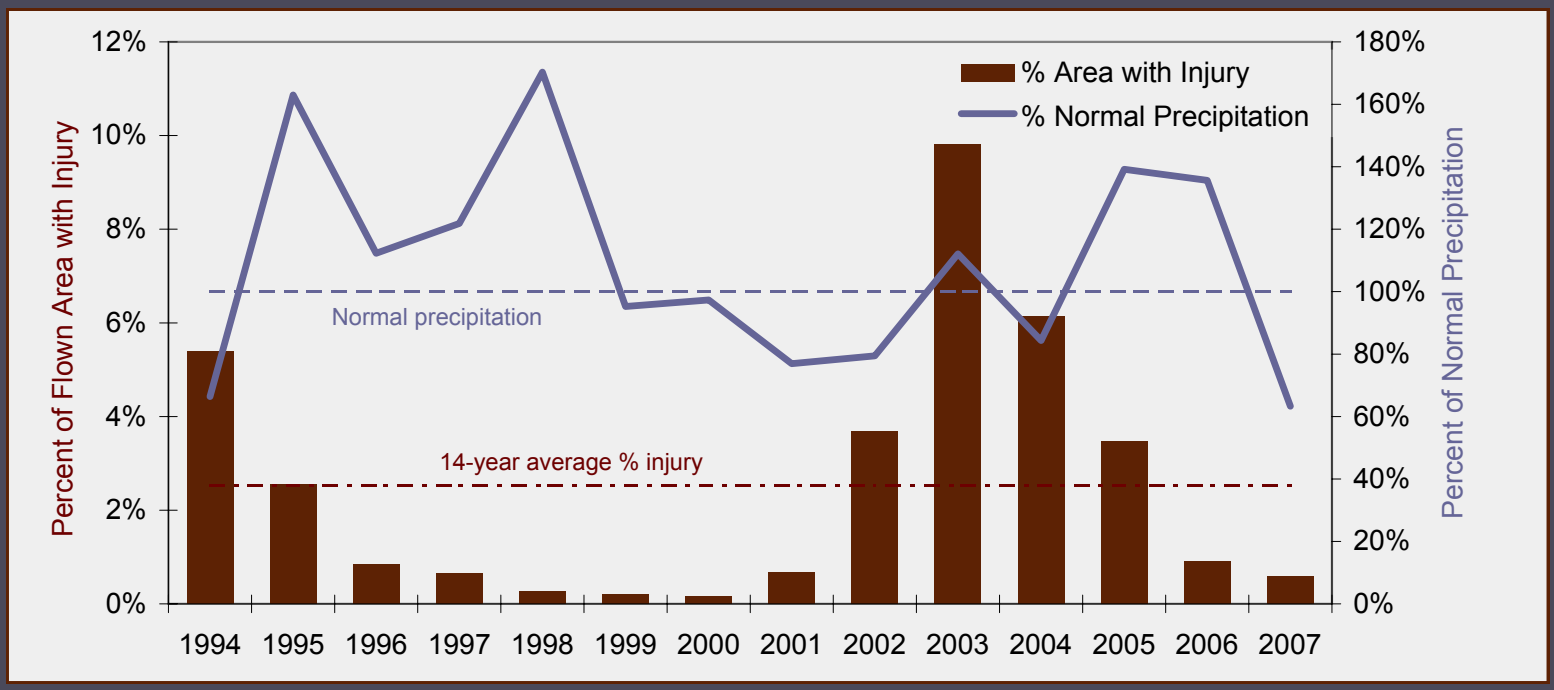
High levels of conifer mortality caused by the mountain pine beetle were observed in the northeast portion of the state (Klamath, Modoc, and Shasta-Trinity National Forests).

Defoliation caused by the douglas-fir tussock moth was not observed from the areas where it was detected in 2006, with the exception of 7,000 acres in or near the Shasta-Trinity National Forest.

Live Oak and Tanoak mortality from sudden oak death continued to advance within currently known infested counties.

Large areas of defoliation (approximately 8,500 acres) caused by California oak worm were observed along the California's central coast.

To download the final aerial detection survey report and learn more about aerial detection monitoring, view standards and metadata, or to download printable maps and data, go to: www.fs.fed.us/r5/spf/fhp.




Statewide aerial survey results: Percent of flown area with injury and percent of normal precipitation; 1994-2007.
Excludes mortality caused by fire.

**Weather**

Information from two sources was used to illustrate meteorological conditions in California over the past few years: the Palmer Drought Indices and data collected by the California Department of Water Resources. The Palmer Drought Index is an indicator of drought or moisture excess and ranges from -6 to +6, with the negative values denoting degree of drought. Moderate to severe drought conditions existed for most of California in 2007. The statewide average snowpack condition in April was 36% of normal. Overall precipitation for the state was at 63% of normal in 2007, following two consecutive years of mostly wet conditions. Drought stress was detected on a number of foothill tree species throughout California in 2007, including: ponderosa pine, gray pine, knobcone cone, incense cedar, California buckeye and blue oak.

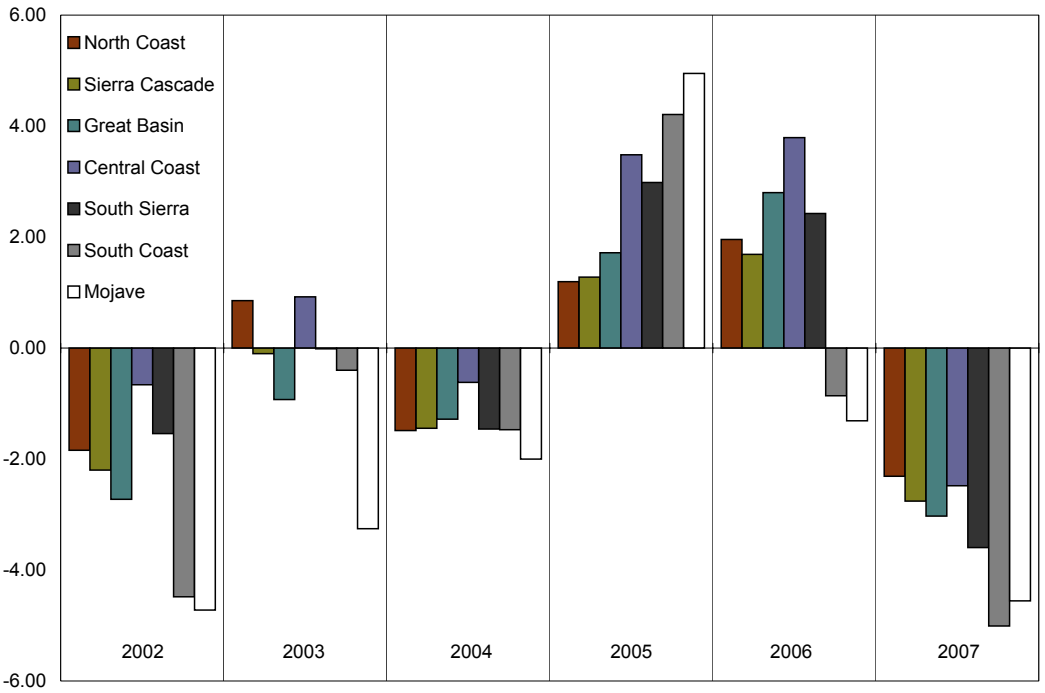
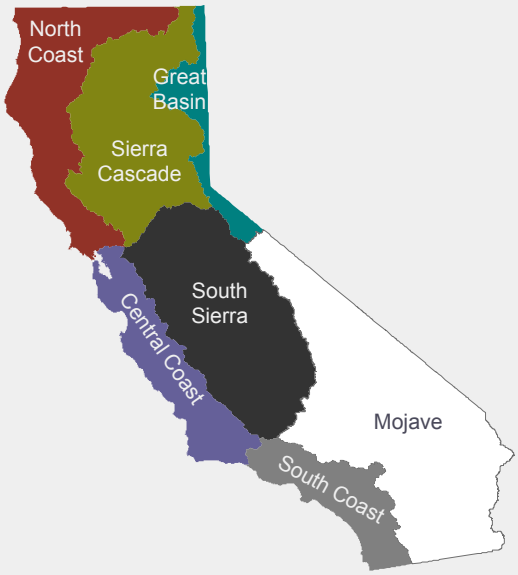


Figure 53. California buckeye shed leaves early due to drought. Photo: D. Cluck




Hydrologic zones in California.

**Effects of Nitric Acid and Ozone on Two Lichen Species in the Los Angeles Air Basin**

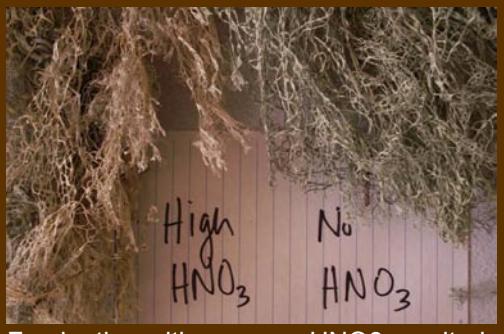
J. Riddell, P. Padgett and T.H. Nash, III

Lichens have been used as biomonitors of air pollution for over a century, beginning in the industrializing European nations in the 1850's. Their usefulness is directly tied to the fact that lichen species are differentially responsive to pollutants, and lichen community composition changes readily with changes in air quality. Monitoring changes in lichen communities allows for early detection of potentially greater ecosystem changes due to changes in air quality. However, for this type of monitoring to be useful, lichen responses need to be calibrated to pollution levels and composition.

Ozone ($O_3$) and nitric acid ($HNO_3$) pollutants usually occur together, as they are formed from the same photochemical reactions between nitrogen oxide (mostly from automobile emissions) and volatile organic compounds. Research on the effects of $O_3$ and $HNO_3$ has focused on toxicity to plants and humans, and the toxicity of $O_3$ to both is well established. Much less is known about the effects of the individual pollutants on lichen biology. Research using fumigation chambers was initiated to test the effects of $HNO_3$ and $O_3$ independantly on the pollution sensitive lichen species *Ramalina menziesii*.

Preliminary results suggest that gaseous $HN0_3$, not $O_3$, may be the driving force behind lichen community composition and depredation in arid regions, where it is an important component of air pollution.

Fumigation chamber.




Fumigation with gaseous HNO3 resulted in *R. menziesii* becoming brown, bleached and brittle.

# Contacts and Additional Information

If you have questions about forest insect and disease activity in California, please contact personnel at one of these regional or field offices.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United States Department of Agriculture

Forest Service Pacific Southwest Region

California Department of Forestry and Fire Protection

California Forest Pest Council


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